

CLAIMS

1. A barbed tape concertina product comprising:

a strand of the product in the form of a continuous helical coil including at least a first pair of loops and a second pair of loops;

a first attachment element at a first attachment point of the first pair of loops
5 and holding the first pair of loops together; and

a second attachment element at a first attachment point of the second pair of loops and holding the second pair of loops together;

wherein the first attachment element is circumferentially offset relative to the second attachment element.

10 2. The barbed tape concertina product of claim 1, wherein the first and second pairs of loops are adjacent pairs of loops.

3. The product of claim 2, further comprising at least one additional attachment element at a second attachment point on the strand in a helically progressive position between the first attachment element and the second attachment element, the at least
15 one additional attachment element holding the first and second pairs of loops together.

4. The product of claim 2, further comprising a plurality of additional attachment elements at respective additional attachment points in helically progressive positions on the strand between the first and second attachment elements.

5. The product of claim 4, wherein the continuous coil further comprises:
20 additional pairs of loops and additional attachment elements holding the loops of each pair together and holding the pairs of loops together;

the attachment elements generally positioned on one pair of loops so that each attachment element is circumferentially offset relative to all other attachment elements on an adjacent pair of loops.

- 5 6. The product of claim 5, wherein the attachment elements are positioned in a predetermined pattern on the continuous coil.
7. The product of claim 6, wherein the pattern is a repeating pattern.
8. The product of claim 6, wherein the pattern provides a predetermined natural configuration of the product when the product is stretched out in a deployed state of use.
- 10 9. The product of claim 8, wherein the pattern provides a donut configuration when the product is stretched out in a deployed state of use.
10. The product of claim 8, wherein the pattern provides a ball configuration when the product is stretched out in a deployed state of use.
- 15 11. One or more attachment elements for holding two adjacent strands of barbed tape concertina product together, the attachment element comprising:
a generally U-shaped staple structure having a central base and a plurality of arms extending from opposite ends of the base in a common direction transverse to the base; wherein:
20 the base has a length between the ends of .410 +/- .0325 inches; and
a distance between the one arm and the pair of arms is .290 +/- .0325 inches.
- 25 12. The one or more attachment elements of claim 11, wherein the base has a length of approximately .410 inches.

13. The one or more attachment elements of claim 11, wherein the distance between the arm and the pair of arms is approximately .290 inches.

5 14. The one or more attachment elements of claim 11, wherein the attachment element comprises one arm supported on one end of the base and a pair of arms supported on the other end of the base for an interleaved configuration when attaching the strands.

10 15. The one or more attachment elements of claim 11, wherein the attachment element is a first attachment element of a plurality of like attachment elements, the attachment elements further comprising:

a pair of slits extending from end to end in the base of each attachment element; and

15 a filament held in each of the slits.

16. The one or more attachment elements of claim 15, wherein:

the filament held in each of first slits is a first common filament that holds the attachment elements together with the first slits of each attachment element aligned with each other; and

20 the filament held in each of second slits is a second common filament that holds the attachment elements together with the second slits of each attachment element aligned with each other.

17. The one or more attachment elements of claim 15, wherein:

25 each of the first and second common filaments comprises a nylon material; and

the common filaments are held in respective first and second slits by a compression fit in each of the slits.

18. The one or more attachment elements of claim 17, wherein:
a material of the attachment element proximate the slits is work hardened; and
each of the attachment elements has a strength greater than or equal to a
strength of an attachment element without slits.

5 19. A barbed tape product, comprising:
a strand of the product in the form of a continuous helical coil;
a first attachment configuration including at least a first attachment point on
the strand;
a second attachment configuration including at least a second attachment point
10 on the strand;
wherein the first and second configurations corresponds to respective first and
second lengths of the strand that each extend through an arc of approximately 360
degrees or more and wherein the first attachment point is circumferentially offset
relative to all second attachment points including the second attachment point.

15 20. The barbed tape product of claim 19, further comprising:
a first attachment at the first attachment point;
a second attachment at the second attachment point;
wherein the first and second attachments attach the first length to the second
length of the strand and the first and second lengths form adjacent first and second
20 loops of the strand corresponding to respective first and second adjacent cycles.

21. The barbed tape product of claim 19, wherein:
the first attachment configuration comprises a plurality of first attachment
points including the first attachment point;
the second attachment configuration comprises a plurality of second
25 attachment points including the second attachment point;
wherein each of the plurality of first attachment points are circumferentially
offset relative to each of the plurality of second attachment points.

22. The barbed tape product of claim 21, further comprising:

a plurality of first attachments at the plurality of first attachment points; and
a plurality of second attachments at the plurality of second attachment points.

23. The barbed tape product of claim 22, wherein the plurality of first attachments and the plurality of second attachments attach first and second pairs of loops
5 comprising adjacent lengths of the strand together, wherein the first and second pairs of loops correspond to respective first and second adjacent cycles in a helically progressive pattern forming a barbed tape concertina product.

24. The barbed tape product of claim 22, wherein the plurality of first attachments and the plurality of second attachments attach first and second adjacent lengths
10 comprising adjacent first and second loops of the strand together, wherein the first and second lengths correspond to respective first and second adjacent cycles in a helically progressive pattern forming a barbed tape product.

25. A method of forming a barbed tape concertina product, the method comprising:
programming an electronic controller for automatically:
15 forming a strand of product in a machine;
coiling the strand of product in loops of a predetermined radius; and
attaching adjacent loops together at predetermined positions along the
strand of product;
operating the machine under electronic controller control to complete
20 operational steps of forming, coiling, and attaching the product.

26. The method of claim 25, wherein the step of attaching comprises:
connecting a first pair of adjacent loops together at a first attachment point at a
first predetermined circumferential position on the coils; and
connecting a second pair of adjacent loops together at a second attachment
25 point at a second predetermined circumferential position on the coils
circumferentially spaced from the first position.

27. The method of claim 26, wherein the first pair of loops is adjacent to the second pair of loops.

28. The method of claim 27, further comprising the steps of connecting the adjacent loops together at one or more additional attachment points in at least one helically progressive circumferential position between the first position and the second position.

29. The method of claim 28, wherein the step of connecting the adjacent loops together by the one or more additional attachment points comprises connecting the adjacent loops together at a plurality of additional attachment points between the first position and the second position in a helically progressive pattern.

30. The method of claim 25, wherein:
the strand of product forms a coil having a predetermined length comprising a plurality of adjacent loops; and
the step of operating the machine to complete the operational step of attaching comprises connecting adjacent loops together at attachment points at predetermined helically progressive circumferential positions in accordance with a predetermined pattern.

31. The method of claim 30, wherein the step of programming for automatically attaching comprises programming the electronic controller for attaching in the predetermined pattern of positions along the strand of product.

32. The method of claim 30, wherein the predetermined pattern is a first pattern, the step of programming comprises programming the electronic controller for attaching in the first pattern for a first roll of product and programming the electronic controller to vary from the first pattern for attaching in a second pattern between rolls or in a second roll of product.

33. The method of claim 25, wherein the step of attaching the product comprises automatically connecting loops of the product at a rate of approximately 125 attachment points in 320 seconds or less.
34. The method of claim 25, wherein the step of attaching the product comprises
5 automatically connecting loops of the product at a rate of approximately 125 attachment points in 300 seconds or less.
35. The method of claim 25, wherein the step of attaching the product comprises automatically connecting loops of the product at a rate of approximately 125
10 attachment points in 240 seconds or less.
36. The method of claim 25, wherein the step of forming the strand of product comprises connecting a strand of tape to a strand of wire in the machine.
37. The method of claim 25, further comprising a step of selecting attachment point
15 placement.
38. The method of claim 37, wherein the step of selecting attachment point placement comprises selecting at least one frequency of the attachment point placement.
39. The method of claim 37, wherein the step of selecting the attachment point
20 placement comprises selecting a plurality of frequencies for the attachment point placement.
40. The method of claim 37, wherein the step of selecting the attachment point placement further comprises forming a dead space or skipping at least one unit in the
25 frequency of the attachment point placement.
41. The method of claim 37, wherein the step of selecting attachment point placement further comprises a preliminary step of preprogramming the electronic controller to automatically place the attachment points.

42. A method of forming a barbed tape concertina product, the method comprising programming an electronic controller for automatically attaching adjacent loops of the product together in a predetermined pattern of positions along a strand of the product forming the loops.

5 43. The method of forming of claim 42, wherein the step of programming further comprises programming the electronic controller to automatically vary the pattern of positions from a first roll of the product to a second roll of the product, the method further comprising automatically forming at least the first and the second rolls of the product and varying the pattern from the first roll of the product to the second roll of
10 the product.

44. The method of forming of claim 42, wherein the step of programming further comprises programming the electronic controller to automatically vary the pattern of positions within a particular roll of the product, the method further comprising
15 automatically forming the roll and varying the pattern within the roll.

45. The method of forming of claim 42, wherein the step of programming further comprises programming the electronic controller to automatically vary the pattern of positions between respective ones of a plurality of rolls, the method further
20 comprising automatically forming the plurality of rolls and varying the pattern for a length of the product between said respective ones of the rolls.

46. A machine for automatically making barbed tape concertina product, the machine comprising an electronic controller operatively connected to an attachment device in the machine for automatically attaching the barbed tape concertina product to itself at
25 predetermined positions to form a roll of the barbed tape concertina product.

47. The machine for automatically making barbed tape of claim 46, further comprising:

a roll former;

a radial bender; and

a take up device;

wherein the electronic controller is operatively connected to the roll former, the radial bender, and the take up device to form the roll of barbed tape concertina product.

5 48. The machine for automatically making barbed tape of claim 46, wherein the attaching device and electronic controller are configured to variably attach adjacent loops of the product together at predetermined attachment points corresponding to the predetermined positions under electronic control.

10 49. The machine for automatically making barbed tape of claim 48, wherein the electronic controller is configured to provide:

 a first set of the attachment points in a predetermined first pattern for a first roll of the product; and

 a second set of the attachment points in a predetermined second pattern for a second roll of the product;

15 wherein the patterns are varied from the first set to the second set.

50. The machine for automatically making barbed tape of claim 48, wherein the electronic controller is configured to provide:

 a first set of the attachment points in a predetermined first pattern for a first roll of the product; and

20 a second set of the attachment points in a predetermined second pattern for a second roll of the product;

 wherein a pattern of the attachment points is varied between the first set and the second set.

25 51. The machine for automatically making barbed tape of claim 48, wherein the electronic controller is configured to provide:

 a set of the attachment points in a predetermined pattern for a roll of the product; and

 a variation of the pattern within the roll.

52. A method of forming a barbed tape product, the method comprising:

programming an electronic controller for automatically:

forming a strand of product in a machine;

coiling the strand of product in loops of a predetermined radius; and

5 connecting adjacent loops together at predetermined positions along
the strand of product;

operating the machine under electronic controller control to complete
operational steps of forming, coiling, and connecting the product.

53. The method of claim 52, wherein the step of connecting comprises:

10 connecting a first loop to a second loop by a spacer line, wherein the step of
connecting comprises:

attaching the spacer line to a first attachment point at a first
predetermined circumferential position on the first loop;

15 attaching the spacer line to a second attachment point at a second
predetermined circumferential position on the second loop;

wherein the first and second loops form at least a portion of the coil and the
first and second attachment points are circumferentially spaced from each other on the
coil.

54. The method of claim 52, wherein the first loop is adjacent to the second loop.

20 55. The method of claim 54, further comprising the steps of connecting the adjacent
loops to each other by one or more additional spacer lines attached to additional
respective first and second attachment points on the first and second loops in helically
progressive circumferential positions on the loops.

25 56. The method of claim 55, further comprising circumferentially offsetting the first
and second attachment points of the second loop relative to the first and second
attachment points of the first loop.

57. A machine for automatically making a barbed tape product, the machine

comprising an electronic controller operatively connected to an attachment device in the machine for automatically attaching at least one object to the barbed tape product in at least one predetermined position on the barbed tape product under electronic control to form a roll of the barbed tape product.

5 58. The machine for automatically making barbed tape product of claim 57, further comprising:

- a roll former;
- a radial bender;
- a take up device;

10 wherein the electronic controller is operatively connected to the roll former, the radial bender, and the take up device to form the roll of the barbed tape product.

59. The machine for automatically making barbed tape of claim 57, wherein the attachment device and electronic controller are configured to variably attach the at least one object to the barbed tape product at a predetermined attachment point
15 corresponding to the predetermined position under electronic control.

60. The machine for automatically making barbed tape of claim 59, wherein the machine is configured to attach a plurality of objects including the at least one object to the barbed tape product.

20 61. The machine for automatically making barbed tape of claim 60, wherein the electronic controller is configured to provide:

- a first set of the attachment points for the plurality of objects in a predetermined first pattern for a first roll of the product; and
- a second set of the attachment points for the plurality of objects in a predetermined second pattern for a second roll of the product;

25 wherein the patterns are varied from the first set to the second set.

62. The machine for automatically making barbed tape of claim 60, wherein the plurality of objects comprises a plurality of dissimilar objects and the attachment

device has a plurality of mechanisms configured for respectively attaching the plurality of dissimilar objects.

63. The machine for automatically making barbed tape of claim 60, wherein the plurality of objects comprises a plurality of similar objects and the attachment device
5 has a plurality of attachment mechanisms configured for respectively attaching the plurality of similar objects.

64. The machine for automatically making barbed tape of claim 60, wherein the electronic controller is configured to provide a first set of attachment points for a first attachment mechanism of the attachment device and a second set of attachment points
10 for a second attachment mechanism of the attachment device.

65. The machine for automatically making barbed tape of claim 60, wherein the attachment device is a first attachment device, the machine further comprising at least a second attachment device configured for attaching respective first and second objects of the plurality of objects.

15 66. The machine for automatically making barbed tape of claim 65, wherein the objects are dissimilar objects and the first and second attachment devices are dissimilar devices configured for attaching the respective first and second dissimilar objects.

20 67. The machine for automatically making barbed tape of claim 65, wherein the objects are similar objects and the first and second attachment devices are similar devices configured for attaching the respective first and second similar objects to the barbed tape product.

68. The machine for automatically making barbed tape of claim 65, wherein the electronic controller is configured to provide a first set of attachment points for the
25 first attachment device and second set of attachment points for the second attachment device.

69. The machine for automatically making barbed tape of claim 60, wherein the electronic controller is configured to provide:

a set of the attachment points for attaching the plurality of objects in a predetermined pattern for a roll of the product; and

5 a variation of the pattern within the roll.

70. A method of forming a barbed tape product, comprising:

forming the product into a helical coil; and

automatically attaching at least one object to a strand of the coil under the control of an electronic controller.

10 71. The method of claim 70, further comprising automatically attaching a plurality of objects including the object to the strand of the coil.

72. The method of claim 71, wherein the plurality of objects includes a plurality of similar objects.

15 73. The method of claim 71, wherein the plurality of objects includes a plurality of dissimilar objects.

74. The method of claim 71, wherein the plurality of objects includes a plurality of lines, the method further comprising automatically attaching the plurality of lines at a plurality of attachment points on at least one loop of the coil.

20 75. The method of claim 74, further comprising
attaching each of the plurality of lines to the plurality of loops including the loop at the plurality of attachment points on the plurality of loops of the coil;
wherein the step of attaching each of the plurality of lines at the plurality of attachment points comprises attaching each of the plurality of lines to the plurality of loops at circumferentially spaced locations on the coil.

25 76. The method of claim 75, further comprising:

attaching the plurality of lines at a first set of attachment points on a first length of the coil;

attaching the plurality of lines at a second set of attachment points on a second length of the coil;

- 5 wherein the steps of attaching further comprise circumferentially offsetting the second set of attachment points relative to the first set of attachment points.

77. The method of claim 76, further comprising:

- alternatingly attaching the plurality of lines at respective first sets of attachment points on a plurality of first lengths including the first length and at
10 respective second sets of attachment points on a plurality of second lengths;
alternating the first and second lengths in a helically progressive pattern along the strand of the coil.

78. The method of claim 71, wherein the step of attaching the plurality of objects comprises attaching at least one fastener and at least one line.

- 15 79. The method of claim 78, wherein the step of attaching at least one line comprises attaching a spacer line.

80. The method of claim 78, wherein the step of attaching at least one line comprises attaching a trip line.

81. The method of claim 78, wherein the step of attaching at least one line comprises
20 attaching a sensor line.

82. The method of claim 78, further comprising attaching at least one marker.

83. The method of claim 71, wherein the step of attaching the plurality of objects comprises attaching at least one spacer line and at least one sensor line.

84. The method of claim 71, wherein the step of attaching the plurality of objects comprises attaching at least one marker.

85. The method of claim 71, wherein the step of attaching the plurality of objects comprises attaching at least one clip.

5 86. The method of claim 71, wherein the step of attaching the plurality of objects comprises attaching the plurality of objects by a single device attached to a take up reel.

87. The method of claim 71, wherein the step of attaching the plurality of objects comprises attaching at least one of the objects inside the coil and another of the
10 objects outside the coil.

88. The method of claim 71, wherein the step of attaching the plurality of objects comprises attaching a first set of objects in a first pattern and a second set of objects in a second pattern.

89. The method of claim 71, wherein the step of attaching the plurality of objects
15 comprises attaching the plurality of objects by a plurality of devices attached to a take up reel.

90. A tape product comprising:
a concertina coil;
at least one of an internal truss and external truss connected to the coil at a
20 plurality of connection points;
wherein the truss strengthens or stabilizes the coil.

91. The tape product of claim 90, wherein the concertina coil is a first concertina coil and the truss is an integral portion of at least one additional concertina coil that intersects with and is connected to the first concertina coil.

25 92. The tape product of claim 90, wherein:

the truss comprises a compression member connected at the connection points to portions of the coil; and
the truss holds the portions away from each other at a predetermined distance.

5 93. The tape product of claim 92, wherein the connection points define a chord of the coil.

94. The tape product of claim 93, wherein:
the truss includes a upright truss connected to the diametrically opposite portions of the coil; and
at least one additional truss is connected to an additional portion of the coil at
10 one or more of additional connection points.

95. The tape product of claim 90, wherein the trusses comprise at least one tension member connected to the coil at one or more of the connection points.

96. The tape product of claim 90, wherein:
the coil is a first coil;
15 the tape product further comprises a second coil; and
the truss suspends the second coil within the first coil.

97. The tape product of claim 90, wherein the truss comprises an external truss that forms a blister or spur extending radially outside an envelope of the coil.

98. The tape product of claim 97, wherein:
20 the truss is a first truss;
the tape product comprises a plurality of trusses including the first truss; and
the plurality of trusses comprises at least one tension member and at least one compression member.

99. The tape product of claim 98, wherein the tension member and the compression
25 member are interconnected to provide the spur.

100. The tape product of claim 98, wherein the plurality of trusses comprise a plurality of upright compression members and a plurality of spurs.

5 101. The tape product of claim 100, further comprising an accessory platform mounted on an end of at least one of the upright compression members.

102. The tape product of claim 97, wherein:
the truss is a first truss;
the tape product includes a plurality of trusses including the first truss; and
10 the plurality of trusses form at least one blister on the coil.

103. A plural coil tape product comprising:
a first concertina coil extending from a first end to a second end of the coil along a first coil axis;
at least a second concertina coil extending generally from a first end to a
15 second end of the coil along a second coil axis; and
the second concertina coil intersecting the first concertina coil in at least partially overlapping side by side relation in a first intersection along the first and second coil axes;
wherein the first intersection comprises connection of the second concertina
20 coil at more than one circumferentially spaced connection point on the first coil.

104. The plural coil tape product of claim 103, further comprising:
at least a third concertina coil extending generally from a first end to a second end of the third coil along a third coil axis;
the third coil intersecting at least one of the first and second coils in at least
25 partially overlapping side by side relation in a second intersection along the first, second, and third axes;

wherein the second intersection comprises connection of the third concertina coil at more than one circumferentially spaced connection points on at least one of the first and second coils.

5 105. The plural coil tape product of claim 104, wherein the third coil intersects both of the first and second coils in overlapping side by side relation so that the first, second, and third coil axes generally define vertices of a triangular configuration of the coil tape product.

10 106. The plural coil tape product of claim 105, wherein each of the first, second, and third coils intersects each of the other coils in at least two connection points.

107. The plural coil tape product of claim 104, wherein at least one of the connection points is also an attachment point for attaching adjacent loops of a coil in a concertina configuration.

15 108. The plural coil tape product of claim 104, further comprising one or more trusses attached to at least one of the first, second, and third coils.

109. A deployment system for deploying and retrieving a concertina tape product, the system comprising:

20 a product magazine having at least one base, a stanchion supported on the base,

and a latch mounted on the stanchion;

25 the stanchion having an upright member extending upwardly from a first end of the base and a cantilever support member with a first end connected to the upright member and a second end extending in overlying relation to the base toward a second end of the base;

the cantilever support member having a connection structure at the second end of the cantilever support member for selectively receiving a gooseneck member; and

the gooseneck member removeably connected at a first end of the gooseneck member to the connection structure in one of at least two configurations.

110. The deployment system of claim 109, wherein the at least two configurations comprise:

- 5 a first deployment configuration in which the gooseneck member extends generally longitudinally aligned with a length of the cantilever support member; and
 a second securing configuration in which the gooseneck member extends generally longitudinally transverse to the length of the cantilever support member.

111. The deployment system of claim 110, wherein:

- 10 the base has a locking structure on a second end of the base; and
 the gooseneck has a mating locking structure on a second end of the gooseneck member releaseably lockable with the locking structure on the base.

112. The deployment system of claim 109, wherein the latch selectively secures the magazine to a vehicle.

- 15 113. The deployment system of claim 112, wherein the vehicle comprises a trailer with a height adjustable load support structure.

114. The deployment system of claim 109, wherein the base has rollers on an underside for rolling engagement with a ground surface.

- 20 115. The deployment system of claim 109, wherein the upright member is a height adjustable upright member.

116. The deployment system of claim 109, wherein the gooseneck member comprises a bend such that when the gooseneck member is attached to the cantilever support member in a first deployment configuration, the bend extends upwardly relative to the cantilever support member.

117. The deployment system of claim 116, wherein the gooseneck member further comprises an eccentric adjustably mounted at the bend to adjustably extend the bend upwardly relative to the cantilever support.

118. A shaped concertina tape product comprising:

- 5 a concertina coil forming an envelope of a predetermined configuration;
 a plurality of trusses connected to the coil;

 wherein the coil is rigidified against forces in one or more direction so that in a deployed state, an original dimension of the envelope in a rigidified direction is maintained while a dimension in a non-rigidified direction is reduced.

- 10 119. The shaped concertina tape product of claim 118, wherein the envelope has an elliptical section in the deployed state.

120. The shaped concertina tape product of claim 118, wherein the envelope has a generally ogive section in the deployed state.

- 15 121. The shaped concertina tape product of claim 120, wherein the trusses comprise upright trusses and the rigidified direction is in a generally vertical direction.

122. The shaped concertina tape product of claim 121, wherein a vertical dimension of
the coil is approximately eighty inches in both the deployed state and the retracted
state and a horizontal dimension is approximately sixty-four inches in the deployed
20 state.

123. The shaped concertina tape product of claim 118, wherein the configuration of the
envelope has a variety of preselected sectional dimensions along a length of the coil.

124. The shaped concertina tape product of claim 118, wherein:

the concertina coil is formed by a plurality concertina coil segments having respective helically progressive strands each having an end connected to an end of an adjacent one of the plurality of concertina coil segments;

5 wherein the strand of each adjacent segment progresses helically in an opposite rotational direction relative to the adjacent coil segment.

125. The shaped concertina tape product of claim 124, wherein the plurality of segments alternately comprise respective clockwise and counterclockwise helically progressive strands connected end to end.

10 126. A plural coil tape product comprising:

a first coil extending from a first end to a second end of the coil along a first coil axis;

at least a second coil extending generally from a first end to a second end of the coil along a second coil axis; and

15 the second coil intersecting the first coil in at least partially overlapping side by side relation in a first intersection along the first and second coil axes;

wherein:

the first intersection forms an internal truss comprising portions of the first and second coils; and

20 a respective plurality of similarly formed internal trusses generally form a repeating pattern of upright ovals along the first and second coil axes when viewed from a side in a deployed state.

127. The plural coil tape product of claim 126, wherein:

the internal truss comprising portions of the first and second coils; and

the respective plurality of similarly formed internal trusses generally form a zig zag pattern along the first and second coil axes when viewed from above in a partially deployed state.

128. The plural coil tape product of claim 126, wherein:

- 5 the internal truss comprises portions of the first and second coils; and
- the internal truss forms a generally upright linear configuration as viewed from an axial end in a fully deployed state.

129. The plural coil tap product of claim 128, further comprising a third coil intersecting the first and second coils in at least one circumferential position of each
- 10 of the first and second coils.

* * * *